ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 635526

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental [] Direct Revision [X] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	Cheryl J. Benar, Data Assessment and Interpretation, R2-12, 372-1256	[] Yes [X] No	08/06/97
	6. Project Title/No./Work Order No. Tank 241-B-110	7. Bldg./Sys./Fac. No. 241-B-110	8. Approval Designator N/A
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.) HNF-SD-WM-ER-368, Rev. 1	10. Related ECN No(s). ECN-635435	11. Related PO No. N/A

12a. Modification Work	12b. Work Package No.	12c. Modification Work Complete	12d. Restored to Original Condition (Temp. or Standby ECN only)
[] Yes (fill out Blk. 12b) [X] No (NA Blks. 12b, 12c, 12d)	N/A	N/A Design Authority/Cog. Engineer Signature & Date	N/A Design Authority/Cog. Engineer Signature & Date

13a. Description of Change 13b. Design Baseline Document? [] Yes [X] No

This ECN was generated to include additional explanatory text in the best-basis narrative, and to update the comprehensive radionuclide inventory estimates for the tank.

14a. Justification (mark one)

Criteria Change	[]	Design Improvement	[X]	Environmental	[]	Facility Deactivation	[]
As-Found	[]	Facilitate Const	[]	Const. Error/Omission	[]	Design Error/Omission	[]

14b. Justification Details

Initial release of this document was deficient.

15. Distribution (include name, MSIN, and no. of copies)

See attached distribution.

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1. ECN (use no. from pg. 1) ECN-635526

16. Design Verification Required	17. Cost Impact				18. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
[] Yes	Additional	[] $	Additional	[] $	Improvement	[]
[X] No	Savings	[] $	Savings	[] $	Delay	[]

19. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 13. Enter the affected document number in Block 20.

SDD/DD	[]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]	Tickler File	[]
Environmental Report	[]	Inspection Plan	[]		[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

20. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
N/A		

21. Approvals

	Signature	Date		Signature	Date
Design Authority			Design Agent		
Cog. Eng. C.J. Benar	C. J. Benar	8/20/97	PE		
Cog. Mgr. K.M. Hall	Kathleen M. Hall	8/20/97	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other			Other		

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

Tank Characterization Report for Single-Shell Tank 241-B-110

Cheryl J. Benar
Lockheed Martin Hanford, Corp., Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

EDT/ECN: ECN-635526 UC: 2070
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Key Words: Waste Characterization, Single-Shell Tank, SST, Tank 241-B -110, 241-B-110, B-110, B Farm, Tank Characterization Report, TCR, Waste Inventory, TPA Milestone M-44

Abstract: This document summarizes the information on the historical uses, present status, and the sampling and analysis results of waste stored in Tank 241-B-110. This report supports the requirements of the Tri-Party Agreement Milestone M-44-05.

8/22/97

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RECORD OF REVISION	(1) Document Number HNF-SD-WM-ER-368	Page 1

(2) Title
Tank Characterization Report for Single-Shell Tank 241-B-110

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release (5) Cog. Engr.	(6) Cog. Mgr. Date
0	(7) Initially released 09/06/94 on EDT-608061.	B.C. Simpson	C.S. Haller
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1-A RS	Incorporate per ECN-635526.	C.J. Benar C.J. Benar 8/20/97	K.M. Hall Kathleen M. Hall 8/20/97

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3.0 BEST-BASIS INVENTORY ESTIMATE

Information about the chemical and/or physical properties of tank wastes is used to perform safety analyses, engineering evaluations, and risk assessments associated with waste management activities, as well as to address regulatory issues. Waste management activities include overseeing tank farm operations and identifying, monitoring, and resolving safety issues associated with these operations and with the tank wastes. Disposal activities involve designing equipment, processes, and facilities for retrieving wastes and processing the wastes into a form that is suitable for long-term storage.

Chemical inventory information generally is derived using two approaches: 1) component inventories are estimated using the results of sample analyses; and 2) component inventories are predicted using a model based on process knowledge and historical information. The most recent model was developed by Los Alamos National Laboratory (LANL) (Agnew et al. 1997). Not surprisingly, information derived from these two different approaches is often inconsistent.

An effort is underway to provide waste inventory estimates that will serve as standard characterization information for the various waste management activities (Hodgson and LeClair 1996). Appendix D contains the complete narrative regarding the derivation of the inventory estimates presented in Tables 3-1 and 3-2.

Table 3-1. Best-Basis Inventory Estimate for Nonradioactive Components in Tank 241-B-110, (Effective September 30, 1996). (2 Sheets)

Analyte	Total Inventory (kg)	Basis (S,M,E, or C)[1]	Comment
Al	1420	S	
Bi	23200	S	
Ca	1010	S	
Cl	1540	S	
TIC as CO_3	5630	S	
Cr	1010	S	
F	2370	S	
Fe	22600	S	
Hg	0	M	
K	390	S	
La	39.8	S	
Mn	83.6	S	
Na	122000	S	

Table 3-1. Best-Basis Inventory Estimate for Nonradioactive Components in Tank 241-B-110, (Effective September 30, 1996). (2 Sheets)

Analyte	Total Inventory (kg)	Basis (S,M,E, or C)[1]	Comment
Ni	23.3	S	
NO_2	12900	S	
NO_3	234000	S	
OH	51900	C	charge balance calculation
P as PO_4	61600	S	P as PO4
Pb	661	S	
S as SO_4	14400	S	S as SO4
Si	11700	S	
Sr	264	S	
TOC	477	S	
U_{TOTAL}	260	S	
Zr	7.82	S	

[1]S=Sample-based
M=Hanford Defined Waste model-based (Agnew et al. 1996)
E=Engineering assessment-based
C=Calculated by charge balance; includes oxides as hydroxides, not including CO_3, NO_2, NO_3, PO_4, SO_4, and SiO_3

Table 3-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-B-110 Decayed to January 1, 1994 (Effective September 30, 1996). (2 Sheets)

Analyte	Total Inventory (Ci)	Basis (S,M,E, or C)[1]	Comment
^{3}H	1.48	M	
^{14}C	0.281	M	
^{59}Ni	1.34	M	
^{60}Co	0.374	M	
^{63}Ni	135	M	
^{79}Se	1.27	M	
^{90}Sr	135000	S	
^{90}Y	135000	S	based on ^{90}Sr
^{93m}Nb	4.37	M	
^{93}Zr	5.82	M	

Table 3-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-B-110 Decayed to January 1, 1994 (Effective September 30, 1996). (2 Sheets)

Analyte	Total Inventory (Ci)	Basis (S,M,E, or C)[1]	Comment
^{99}Tc	20.7	S	
^{106}Ru	0.00433	M	
^{113m}Cd	24.9	M	
^{125}Sb	1.67	M	
^{126}Sn	1.98	M	
^{129}I	0.045	S	
^{134}Cs	0.0887	M	
^{137m}Ba	17600	S	based on ^{137}Cs
^{137}Cs	18600	S	
^{151}Sm	4730	M	
^{152}Eu	1.45	M	
^{154}Eu	83	M	
^{155}Eu	108	M	
^{226}Ra	8.47 E-05	M	
^{227}Ac	4.56 E-04	M	
^{228}Ra	7.91 E-10	M	
^{229}Th	1.25 E-07	M	
^{231}Pa	0.00103	M	
^{232}Th	7.18 E-11	M	
^{232}U	4.40 E-06	M	
^{233}U	2.39 E-07	M	
^{234}U	0.301	M	
^{235}U	0.0135	M	
^{236}U	0.00219	M	
^{237}Np	0.14	S	
^{238}Pu	1.44	M	
^{238}U	0.305	M	
^{239}Pu	96.4	M	
^{240}Pu	10.5	M	
^{241}Am	90.7	S	
^{241}Pu	88.2	M	
^{242}Cm	0.0399	M	

Table 3-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-B-110 Decayed to January 1, 1994 (Effective September 30, 1996). (2 Sheets)

Analyte	Total Inventory (Ci)	Basis (S,M,E, or C)[1]	Comment
^{242}Pu	4.93 E-04	M	
^{243}Am	0.00134	M	
^{243}Cm	0.00306	M	
^{244}Cm	0.094	M	

[1]S=Sample-based
M=Hanford Defined Waste model-based (Agnew et al. 1997)
E=Engineering assessment-based

APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-B-110

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-B-110

The following evaluation provides a best-basis inventory estimate for chemical and radionuclide components in tank 241-B-110.

D1.0 IDENTIFY/COMPILE INVENTORY SOURCES

The report by Heasler et al. (1993) provides a statistical evaluation of the sample results from the 1989 sampling event of tank 241-B-110. Of the eight core samples obtained, seven were chemically analyzed. A sample-based inventory was prepared based on the core sample analytical results, a waste density of 1.35 g/mL, and a waste solids volume of 927 kL (245 kgal). The HDW model (Agnew et al. 1996) provides tank contents estimates derived from process flowsheets and waste volume records. Hanlon (1996) gives a total waste volume of 931 kL (246 kgal); this includes 4 kL (1 kgal) of supernate.

D2.0 COMPARE COMPONENT INVENTORY VALUES AND NOTE SIGNIFICANT DIFFERENCES

Tables D2-1 and D2-2 show the sample-based inventory estimate from 1989 analytical data and the inventory estimate from HDW model (Agnew et al. 1996) for tank 241-B-110. (The chemical species are reported without charge designation per the best-basis inventory convention). The sample-based inventory in Table D2-1 is based on values reported by Heasler et al. (1993). The waste solids volume used to generate the sample-based inventory is 927 kL (245 kgal), and the waste solids volume in the HDW model is 931 kL (246 kgal). The estimates use different waste densities. The sample-based inventory used a bulk density of 1.35 g/mL. The measured bulk densities of several core sample segments ranged from 1.32 to 1.37 g/mL. The HDW model uses a lower waste density of 1.20 g/mL. The density difference results in an RPD for analytes with the same concentration of 11.8 percent. Significant differences between the sample-based and HDW model inventories are apparent, for example, Al, Bi, Ca, Cl, Cr, K, Na, NH_4, Ni, NO_2, NO_3, Pb, Si, S, U, and Zr vary by a factor of two or more.

Table D2-1. Sample- and Hanford Defined Waste Model-Based Inventory Estimates for Nonradioactive Components in Tank 241-B-110. (2 sheets)

Analyte	Sampling Inventory Estimate (kg)	HDW Model Inventory[1] Estimate (kg)	Analyte	Sampling Inventory Estimate (kg)	HDW Model Inventory[1] Estimate (kg)
Al	1,420	0	Ni	23.3	112
Ag	58.5	n/r	NO_2	12,900	382
As	n/r	n/r	NO_3	2.34E+05	47,900
B	62	n/r	OH	n/r	33,200
Ba	17.7	n/r	oxalate	n/r	n/r
Be	n/r	n/r	Pb	661	0
Bi	23,200	13,700	Pd	n/r	n/r
Ca	1,010	7,420	P as PO_4	61,600	57,200
Ce	46.5	n/r	Pt	n/r	n/r
Cd	6.62	n/r	Re	8.1	n/r
Cl	1,540	675	Rh	n/r	n/r
Co	n/r	n/r	Ru	139	n/r
Cr	1,010	197	Sb	n/r	n/r
Cr^{+3}	n/r	197	Se	n/r	n/r
Cr^{+6}	n/r	n/r	Si	11,700	1,870
Cs	n/r	n/r	S as SO_4	14,400	3,080
Cu	53.2	n/r	Sn	n/r	n/r
F	2,370	2,560	Sr	264	0
Fe	22,600	35,400	Te	24.1	n/a
FeCN/CN	n/r	n/r	TIC as CO_3	5,630	11,100
formate	n/r	n/r	Th	n/r	n/r
Hg	n/r	0	Ti	10.5	n/r
K	390	162	TOC	477	n/r
La	39.8	0	U_{TOTAL}	260	488

Table D2-1. Sample- and Hanford Defined Waste Model-Based Inventory Estimates for Nonradioactive Components in Tank 241-B-110. (2 sheets)

Analyte	Sampling Inventory Estimate (kg)	HDW Model Inventory[1] Estimate (kg)	Analyte	Sampling Inventory Estimate (kg)	HDW Model Inventory[1] Estimate (kg)
Li	n/r	n/r	V	3.49	n/r
Mg	223	n/r	W	n/r	n/r
Mn	83.6	n/r	Zn	101	n/r
Mo	16.9	n/r	Zr	7.82	0
Na	1.22E+05	63,400	H_2O(wt %)	58.1	75.1
Nd	19.9	n/r	Density (kg/L)	1.35	1.20
NH_4	n/r	49.4			

Notes:
n/r = not reported
[1](Agnew et al. 1996)

Table D2-2. Sample- and HDW Model-Based Inventory Estimates for Radioactive Components in Tank 241-B-110.

Analyte	Sampling Inventory Estimate (Ci)	HDW Model Inventory[1] Estimate (Ci)	Analyte	Sampling Inventory Estimate (Ci)	HDW Model Inventory[1] Estimate (Ci)
^{14}C	n/r	0.281	^{237}Np	0.14	4.56E-03
^{90}Sr	1.35E+05	1.85E+05	^{239}Pu	n/r	96.4
^{99}Tc	20.7	1.99	^{241}Am	91	43.6
^{129}I	0.045	3.85E-03	Total α	195	n/r
^{137}Cs	18,600	8,250	^{154}Eu	n/r	83.0

Notes:
n/r = not reported
[1]Agnew et al. (1997)

D3.0 REVIEW AND EVALUATION OF COMPONENT INVENTORIES

The following evaluation of tank contents is performed to identify potential errors and/or missing information that could influence the sample-based and HDW model component inventories.

D3.1 CONTRIBUTING WASTE TYPES

Tank 241-B-110 was put into service in May 1945 as the first tank in the 241-B-110, 241-B-111, and 241-B-112 cascade. The cascade received 2C waste from B Plant. Waste began overflowing to tank 241-B-111 in December 1945, and tank 241-B-111 overflowed to tank 241-B-112 in April 1946. Tank 241-B-112 was filled in August 1946, and the 2C waste was diverted to the cascade made up of tanks 241-B-104, 241-B-105, and 241-B-106. After tanks 241-B-104, 241-B-105, and 241-B-106 were filled, the supernatant from tanks 241-B-110, 241-B-111, and 241-B-112 was pumped to cribs. The 241-B-110 tank cascade began receiving 2C waste again from B Plant in July 1950 and continued receiving waste until B Plant was shut down in June 1952. Tank 241-B-112 began overflowing to a crib in the second quarter of 1951 (Anderson 1990). After B Plant was shut down in June 1952, the tank 241-B-110 cascade began receiving a concentrated flush waste from B Plant. In 1963, tank 241-B-110 began receiving fission product waste from B Plant.

Table D3-1 shows the current waste volumes for the tanks in the 241-B-110 tank cascade (Hanlon 1996).

Table D3-1. Waste Inventory of the 241-B-110, 241-B-111, and 241-B-112 Tank Cascade.

Waste Volume (kL)	Tank 241-B-110	Tank 241-B-111	Tank 241-B-112
Sludge	927	893	114
Saltcake	0	0	0
Supernatant	4	4	11
Drainable liquid	87	79	0

Table D3-2 lists the documented quantities of waste discharged to tank 241-B-110 from the HDW model waste transaction database. These records indicate that bismuth phosphate 2C waste should be the major constituent of the waste in this tank.

Table D3-2. Waste Transaction Information for Tank 241-B-110.[1]

	Waste Type	Waste Volume (kL)
Waste throughput	2C1	7,960
	2C2	16,450
	DW	556
	P2	2,551
	B	511
	CSR	753
Total waste throughput		28,781
Current inventory		931

Note:

CSR = Waste from cesium recovery from supernates
B = Waste from PUREX acidified waste processed for Sr extraction

[1]Agnew et al. (1996)

Table D3-3 compiles the types of solids in tank 241-B-110 as reported by various authors. All sources indicate that second cycle bismuth phosphate waste should be the principal contributor to tank waste solids.

Table D3-3. Expected Solids for Tank 241-B-110.

Reference	Type
Anderson (1990)	2C, 5-6, FP, FP-EB, BL-EB, BL-IX, IX
HTCE (Brevick et al. 1994)	2C, P2
SORWT model (Hill et al. 1995)	2C, 5-6, FP, IX
HDW model (Agnew et al. 1996)	2C1, 2C2, DW, P2, CSR

Note:

BL = B Plant low-level waste
SORWT = sort on radioactive waste type

D3.2 EVALUATION OF TECHNICAL FLOWSHEET INFORMATION

Table D3-4 summarizes the estimate of bismuth phosphate waste discharged to the 241-B-110 tank cascade made in the tank farm process history and the reconstructed fuel processing history.

Table D3-4. B Plant Fuel Processing and 2C Waste Disposition.

Cascade	Period	Fuel Processed (MTU)
Tanks 241-B-110/241-B-111/241-B-112	May 1945 to August 1946	631
Tanks 241-B-104/241-B-105/241-B-106	September 1946 to June 1950	1,312
Tanks 241-B-110/241-B-111/241-B-112	July 1950 to August 1952	823

Note:
MTU = metric tons of uranium

It is possible to estimate of the amount of 2C waste discharged to each cascade from the fuel process history and the flowsheet information. The technical manual flowsheet applies to the first period, and the Schneider (1951) flowsheet applies to the last two periods. The technical manual issued in 1994 is considered to represent early B Plant operations, and the Schneider (1951) flowsheet is considered to represent later years. Table D3-5 shows the results of this calculation.

Table D3-5. Disposition of B Plant 2C Waste.

Period	May 1945 to August 1946	September 1946 to June 1950	July 1950 to August 1952	Total
Cascade	241-B-110	241-B-104	241-B-110	B Plant
Fuel processed (MTU)	631	1,312	823	2,766
Waste Component (kg)				
Bi	8,990	23,900	15,000	47,900
Cr	421	1,190	748	2,360
F	19,900	54,100	33,900	1.08E+05
Fe	8,610	31,000	19,400	59,000
Na	2.83E+05	6.75E+05	4.23E+05	1.38E+06
NO_3	3.64E+05	1.13E+06	7.08E+05	2.20E+06
Si	4,970	13,100	8,200	26,300
PO_4	2.35E+05	4.23E+05	2.65E+05	9.23E+05
SO_4	29,500	1.07E+05	66,800	2.03E+05

Table D3-6 compares the calculated discharge to the 241-B-110 cascade to the sample-based inventory for tanks 241-B-110 and 241-B-111. Table D3-1 shows nearly equal accumulations of sludge in tanks 241-B-110 and 241-B-111. Table D3-7 compares the tank 241-B-110 sample-based estimate and HDW model estimate to the projected receipts of the tank 241-B-110 cascade. The waste transaction records state both inventories are 2C waste. Better agreement exists between the flowsheet-based estimate and the sample-based estimate for the species most likely to precipitate (Bi, Cr, Fe, and Si) than any other combination.

The sample-based data for tank 241-B-110 almost fully account for the 2C waste discharged to the 241-B-110 cascade. Although this is the expected result for the first tank in a cascade, it is at odds with the large inventory of bismuth bearing sludge found in tank 241-B-111.

Heasler et al. (1993) provides a statistical evaluation of the sample results for the seven core samples. Little vertical variability or horizontal stratification exist except for a crust over the sludge. The crust is quite different chemically from the waste below it. This is consistent with the later addition of 5-6 and FP waste. Photographs of the tank interior show an orange or brown dark waste surface. Some of the surface has the appearance of mud from a dried lake bottom. Other areas appear to be covered with a thin layer of liquid.

Table D3-6. Comparison of Tanks 241-B-110 and 241-B-111 Inventory Estimates to the 241-B-110 Cascade Receipts.

Waste Component (kg)	Tank 241-B-110 Sample-Based Inventory Estimate (kg)	Tank 241-B-111 Sample-Based Inventory Estimate (kg)	Calculated Inventory Discharged to Cascade (kg)
Bi	23,200	21,500	24,000
Cr	1,010	1,180	1,170
F	2,370	1,660	53,800
Fe	22,600	18,900	28,000
Na	1.22E+05	1.02E+05	7.06E+05
NO_3	2.34E+05	87,400	1.07E+06
Si	11,700	11,100	13,200
PO_4	61,600	51,800	5.00E+05
SO_4	14,400	12,400	96,300

Table D3-7. Comparison of Tank 241-B-110 Inventory Estimates to the Total Cascade Receipts.

Waste Component (kg)	Sample Based Inventory Estimate (kg)	HDW Model Inventory Estimate (kg)	Total Calculated Inventory Discharged to Cascade (kg)	HDW Cascade B-110, B-111, B-112, Retained (kg)
Bi	23,200	13,700	24,000	21,000
Cr	1,010	197	1,170	792
F	2,370	2,560	53,800	4,400
Fe	22,600	35,400	28,000	89,600
Na	1.22E+05	63,400	7.06E+05	1.21E+05
NO_3	2.34E+05	47,900	1.07E+06	1.08E+05
Si	11,700	1,870	13,200	6,660
PO_4	61,600	57,200	5.00E+05	69,000
SO_4	14,400	3,080	96,300	7,930

Document Element Basis. In the flowsheet analysis, Bi, Cr, Fe, Si, PO_4, and sulfate analysis are assumed to fully precipitate. The flowsheet analysis for the Bi, Cr, Fe, and Si reconciles best with the sample-based estimate. The HDW model reconciles better with the sample-based estimate for PO_4 and SO_4.

Fluoride, Na, NO_2, and NO_3 inventories cannot be reconciled because these components are relatively soluble, and most would have exited the tank by the cascade system. The best source of information with respect to these compounds is the sample-based estimate.

Significant differences exist between sample-based and HDW model inventories, for example, Al, Bi, Ca, Cl, Cr, K, Na, NH_4, Ni, NO_2, NO_3, Pb, Si, S, U, and Zr vary by a factor of two or more.

Once the best basis inventories were determined, the hydroxide inventory was calculated by performing a charge balance with the valences of other analytes. In some cases this approach requires that other analyte (e.g., sodium or nitrate) inventories be adjusted to achieve the charge balance. During such adjustments the number of significant figures is not increased. This charge balance approach was consistent with that used by Agnew et al. (1996).

D4.0 DEFINE THE BEST-BASIS AND ESTABLISH COMPONENT INVENTORIES

The results from this evaluation are based on sampling data for tank 241-B-110 for the following reasons:

1. Analytical results from composite cores samples from four different risers were used to estimate the component inventories.

2. The sample-based inventory agrees with composition of bismuth phosphate 2C waste, provided it is assumed that the primary source of sludge is bismuth phosphate 2C waste.

These results are subject to future review because of lack of reconciliation to the flowsheet projected inventory. Tables D4-1 and D4-2 show the best-basis inventory estimates for tank 241-B-110. The inventory values reported in Tables D4-1 and D4-2 are subject to change. Refer to the Tank Characterization Database (TCD) for the most current inventory values.

Best-basis tank inventory values are derived for 46 key radionuclides (as defined in Section 3.1 of Kupfer et al. 1997), all decayed to a common report date of January 1, 1994. Often, waste sample analyses have only reported ^{90}Sr, ^{137}Cs, $^{239/240}$Pu, and total uranium, or (total beta and total alpha) while other key radionuclides such as ^{60}Co, ^{99}Tc, ^{129}I, ^{154}Eu, ^{155}Eu, and ^{241}Am, etc., have been infrequently reported. For this reason it has been necessary to derive most of the 46 key radionuclides by computer models. These models estimate radionuclide activity in batches of reactor fuel, account for the split of radionuclides to various separations plant waste streams, and track their movement with tank waste transactions. (These computer models are described in Kupfer et al. 1997, Section 6.1 and in Watrous and Wootan 1997.) Model generated values for radionuclides in any of 177 tanks are reported in the Hanford Defined Waste Rev. 4 model results (Agnew et al. 1997). The best-basis value for any one analyte may be either a model result or a sample or engineering assessment-based result if available. (No attempt has been made to ratio or normalize model results for all 46 radionuclides when values for measured radionuclides disagree with the model.) For a discussion of typical error between model derived values and sample derived values, see Kupfer et al. 1997, Section 6.1.10.

Best-basis tables for chemicals and only four radionuclides (^{90}Sr, ^{137}Cs, Pu and U) were being generated in 1996, using values derived from an earlier version (Rev. 3) of the Hanford Defined Waste model. When values for all 46 radionuclides became available in Rev 4 of the HDW model, they were merged with draft best-basis chemical inventory documents. Defined scope of work in FY 1997 did not permit Rev. 3 chemical values to be updated to Rev. 4 chemical values.

Table D4-1. Best-Basis Inventory Estimate for Nonradioactive Components in Tank 241-B-110, (Effective September 30, 1996). (2 Sheets)

Analyte	Total Inventory (kg)	Basis (S,M,E, or C)[1]	Comment
Al	1420	S	
Bi	23200	S	
Ca	1010	S	
Cl	1540	S	
TIC as CO_3	5630	S	
Cr	1010	S	
F	2370	S	
Fe	22600	S	
Hg	0	M	
K	390	S	
La	39.8	S	
Mn	83.6	S	
Na	122000	S	
Ni	23.3	S	
NO_2	12900	S	
NO_3	234000	S	
OH	51900	C	charge balance calculation

Table D4-1. Best-Basis Inventory Estimate for Nonradioactive Components in Tank 241-B-110, (Effective September 30, 1996). (2 Sheets)

Analyte	Total Inventory (kg)	Basis (S,M,E, or C)[1]	Comment
P as PO_4	61600	S	P as PO4
Pb	661	S	
S as SO_4	14400	S	S as SO4
Si	11700	S	
Sr	264	S	
TOC	477	S	
U_{TOTAL}	260	S	
Zr	7.82	S	

[1]S=Sample-based
M=Hanford Defined Waste model-based (Agnew et al. 1996)
E=Engineering assessment-based
C=Calculated by charge balance; includes oxides as hydroxides, not including CO_3, NO_2, NO_3, PO_4, SO_4, and SiO_3

Table D4-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-B-110 Decayed to January 1, 1994 (Effective September 30, 1996). (2 Sheets)

Analyte	Total Inventory (Ci)	Basis (S,M,E, or C)[1]	Comment
^{3}H	1.48	M	
^{14}C	0.281	M	
^{59}Ni	1.34	M	
^{60}Co	0.374	M	
^{63}Ni	135	M	
^{79}Se	1.27	M	
^{90}Sr	135000	S	
^{90}Y	135000	S	based on ^{90}Sr
^{93m}Nb	4.37	M	
^{93}Zr	5.82	M	
^{99}Tc	20.7	S	
^{106}Ru	0.00433	M	
^{113m}Cd	24.9	M	
^{125}Sb	1.67	M	
^{126}Sn	1.98	M	
^{129}I	0.045	S	
^{134}Cs	0.0887	M	
^{137m}Ba	17600	M	based on ^{137}Cs
^{137}Cs	18600	S	
^{151}Sm	4730	M	
^{152}Eu	1.45	M	
^{154}Eu	83	M	
^{155}Eu	108	M	
^{226}Ra	8.47 E-05	M	
^{227}Ac	4.56 E-04	M	
^{228}Ra	7.91 E-10	M	
^{229}Th	1.25 E-07	M	
^{231}Pa	0.00103	M	
^{232}Th	7.18 E-11	M	
^{232}U	4.40 E-06	M	
^{233}U	2.39 E-07	M	
^{234}U	0.301	M	

Table D4-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-B-110 Decayed to January 1, 1994 (Effective September 30, 1996). (2 Sheets)

Analyte	Total Inventory (Ci)	Basis (S,M,E, or C)[1]	Comment
^{235}U	0.0135	M	
^{236}U	0.00219	M	
^{237}Np	0.14	S	
^{238}Pu	1.44	M	
^{238}U	0.305	M	
^{239}Pu	96.4	M	
^{240}Pu	10.5	M	
^{241}Am	90.7	S	
^{241}Pu	88.2	M	
^{242}Cm	0.0399	M	
^{242}Pu	4.93 E-04	M	
^{243}Am	0.00134	M	
^{243}Cm	0.00306	M	
^{244}Cm	0.094	M	

[1]S=Sample-based
M=Hanford Defined Waste model-based (Agnew et al. 1997)
E=Engineering assessment-based

D5.0 APPENDIX D REFERENCES

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